

2015 EK60 Calibration Report

NOAA Ship *Okeanos Explorer*

EX-15-02L2: Caribbean Exploration (Mapping)

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Introduction

NOAA Ocean Exploration is the only federal program dedicated to exploring the deep ocean, closing prominent gaps in our basic understanding of U.S. deep waters and the seafloor and delivering the ocean information needed to strengthen the economy, health, and security of our nation.

Using the latest tools and technology, NOAA Ocean Exploration explores previously unknown areas of our deep ocean, making discoveries of scientific, economic, and cultural value. Through live video streams, online coverage, training opportunities, and real-time events, NOAA Ocean Exploration allows scientists, resource managers, students, members of the general public, and others to actively experience ocean exploration, expanding available expertise, cultivating the next generation of ocean explorers, and engaging the public in exploration activities. To better understand our ocean, we make exploration data available to the public. This allows us, collectively, to more effectively maintain ocean health, sustainably manage our marine resources, accelerate our national economy, and build a better appreciation of the value and importance of the ocean in our everyday lives.

This document provides all the information for the NOAA Ocean Exploration 2015 calibration of the Simrad EK60 echosounder on NOAA Ship *Okeanos Explorer* during EX-15-02-L1. The calibration occurred on March 4, 2015 in the Carribean. During this procedure, the 18 kilohertz (kHz) was calibrated at maximum power at the 0.512, 1.024, 2.048 and 4.096 ms.

Location and Conditions

- The ship was located off of the Carribean at coordinates 65° 6" W, 18° 36" N for the calibration on March 4, 2015.
- A conductivity, temperature, depth (CTD) cast was performed before commencing calibration to obtain the required water properties necessary for calibration, including the temperature and salinity at the depth of the sphere.
- Average speed of sound at the calibration depth (~ 15 meters) was 1542.6 meters per second.

Calibration Parameters

- The 18 kHz was calibrated at 0.512, 1.024, 2.048 and 4.096 ms.
- Ping rate was 1 ping/second.
- Power was set to maximum: 2000 W.
- See **Table 1** of this document for a complete list of parameters used during calibration.

Table 1. List of relevant parameters and initial settings used during the 2015 calibration of the EK60 18 kHz echosounder. For more information, see Appendix A containing the calibration results for each frequency calibrated.

Frequency (kHz)	18	18	18	18
GPT serial number	009072066c0e	009072066c0e	009072066c0e	009072066c0e
EK 80 software version	2.1.0.12	2.1.0.12	2.1.0.12	2.1.0.12
Transducer model	ES18-11	ES18-11	ES18-11	ES18-11
Transducer serial number	2097	2097	2097	2097
Transducer draft setting (m)	5.65	5.65	5.65	5.65
Transmit power (W)	2000	2000	2000	2000
Pulse length (ms)	4.096	2.048	1.024	0.512
Two-way beam angle (dB)	-17.0	-17.0	-17.0	-17.0
Transducer peak gain (dB)	23.00	22.90	22.40	20.30
Sa correction (dB)	0.00	0.00	0.00	0.00
Absorption coefficient (dB/km)	0.0016	0.0016	0.0016	0.0016
Speed of sound (m/s)	1542.6	1542.6	1542.6	1542.6
3 dB beamwidth (°) alongship/athwartship	10.39/11.10	10.49/11.08	10.72/11.23	11.00/11.00
Angle offset (°) alongship/athwartship	0.04/0.12	0.06/0.18	0.08/0.23	0.00/0.00

Calibration Procedure

To calibrate the 18 kHz transducer a 64 mm copper sphere was used. The 18 kHz transducer is located towards the port aft side of the transducer fairing on the hull. Reference Appendix C for the X, Y, and Z hull locations of the transducer.

Calibrations were performed using Simrad's ER60 calibration software (version 2.1.0.12). For the setup of the downriggers, consult the NOAA Ocean Exploration Standard Operating Procedure: EK60/EK80 Calibration¹. The three calibration lines were joined using typical calibration procedures (lowering a rope under the bow with the starboard side calibration line attached to the end of it and retrieving the rope from the port side once passed under the keel). Prior to deployment, the sphere was soaked in a soapy water solution to break surface tension. The sphere was then lowered to a depth of approximately 15 m from the surface of the water.

The target strength (TS) of the sphere used for calibration was calculated based on the CTD measurements of salinity, temperature, and depth of the sphere. See **Table 2** for the TS values of the sphere for each pulse length and consult the Location and Conditions section for the sound speed values. For each frequency, the sphere was initially positioned in the center of the transducer beam (on-axis) and data were recorded for several minutes. The sphere was moved throughout the beam to achieve adequate coverage.

Table 2. Target strength (TS; units=dB) values of the spheres used during calibration based on the values calculated from the speed of sound at the sphere depth.

18 kHz Pulse Length (ms)	64 mm diameter copper sphere TS (dB)
4.096	-34.27
2.048	-34.30
1.024	-34.30
0.512	-34.27

Calibration Results

There was very good beam coverage for the various pulse lengths of the 18 kHz and root mean square (RMS) error values below the recommended 0.4 threshold (per manufacturer recommendations). All calibration results are detailed in **Table 3**. See Appendix A for beam coverage and error values of each of the calibrated frequencies. All .raw and .txt files were

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saved and recorded and the updated calibration settings were applied to each transducer. See Appendix B for a complete list of the .raw and .txt files recorded during calibration.

Table 3. 2015 calibration results. See Appendix A for the screenshots detailing the results from the 2015 calibration.

18 kHz: Pulse length: 4.096 ms	March 2015 results
Transducer peak gain (dB)	21.86
Sa correction (dB)	-0.36
Beamwidth (°) alongship/athwartship	10.52/11.15
Beam offset (°) alongship/athwartship	0.06/0.07
RMS deviation beam/polynomial model (dB)	0.36/0.33
18 kHz: Pulse length: 2.048 ms	March 2015 results
Transducer peak gain (dB)	21.92
Sa correction (dB)	-0.67
Beamwidth (°) alongship/athwartship	10.39/11.10
Beam offset (°) alongship/athwartship	0.04/0.12
RMS deviation beam/polynomial model (dB)	0.20/0.18
18 kHz: Pulse length: 1.024 ms	March 2015 results
Transducer peak gain (dB)	21.59
Sa correction (dB)	-0.81
Beamwidth (°) alongship/athwartship	10.49/11.08
Beam offset (°) alongship/athwartship	0.06/0.18
RMS deviation beam/polynomial model (dB)	0.18/0.16
18 kHz: Pulse length: 0.512 ms	March 2015 results
Transducer peak gain (dB)	20.30
Sa correction (dB)	-0.67
Beamwidth (°) alongship/athwartship	10.72/11.23
Beam offset (°) alongship/athwartship	0.08/0.23
RMS deviation beam/polynomial model (dB)	0.20/0.19

Appendix A: Calibration Results

18 kHz: 4.096 ms

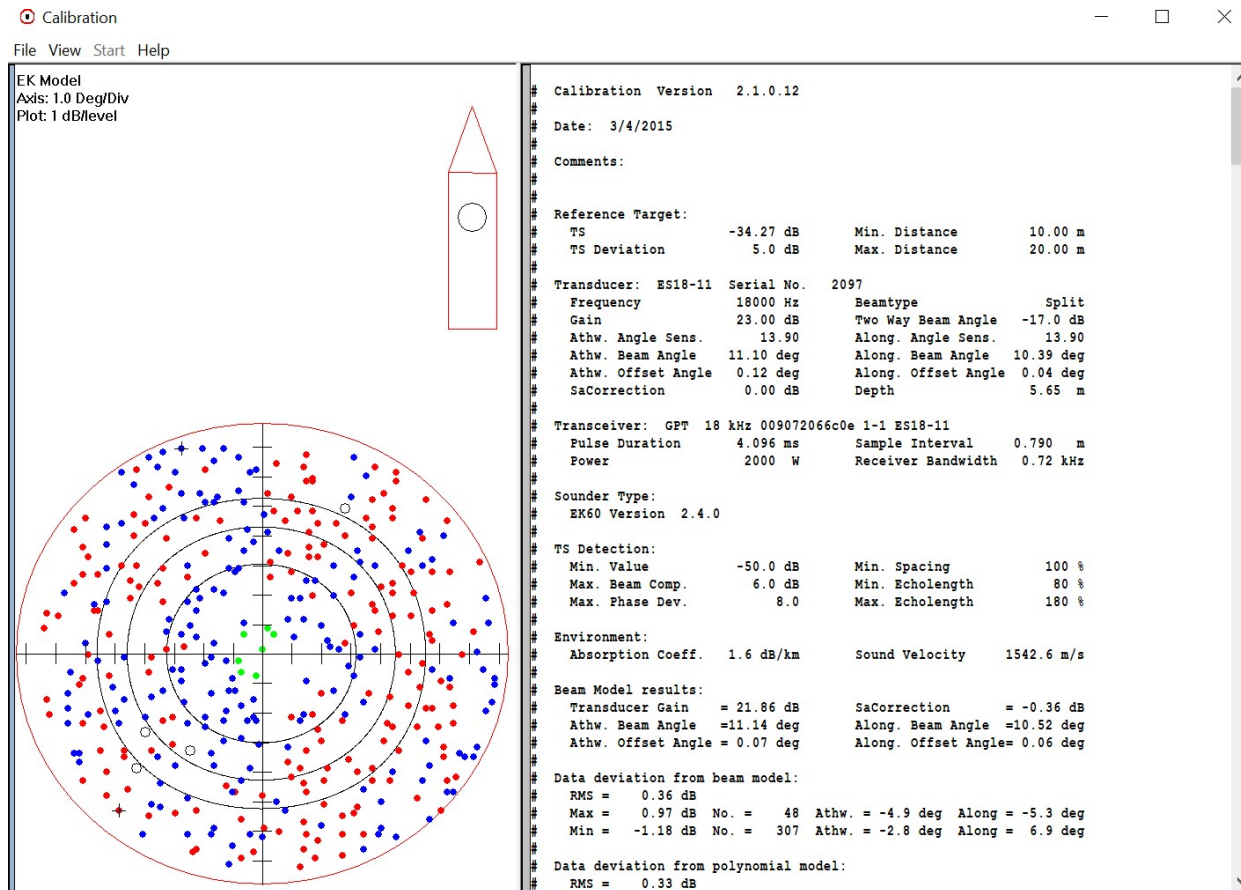


Figure 1. Screenshot of ER60 software calibration results for 18 kHz calibration at 4.096 ms.

18 kHz: 2.048 ms

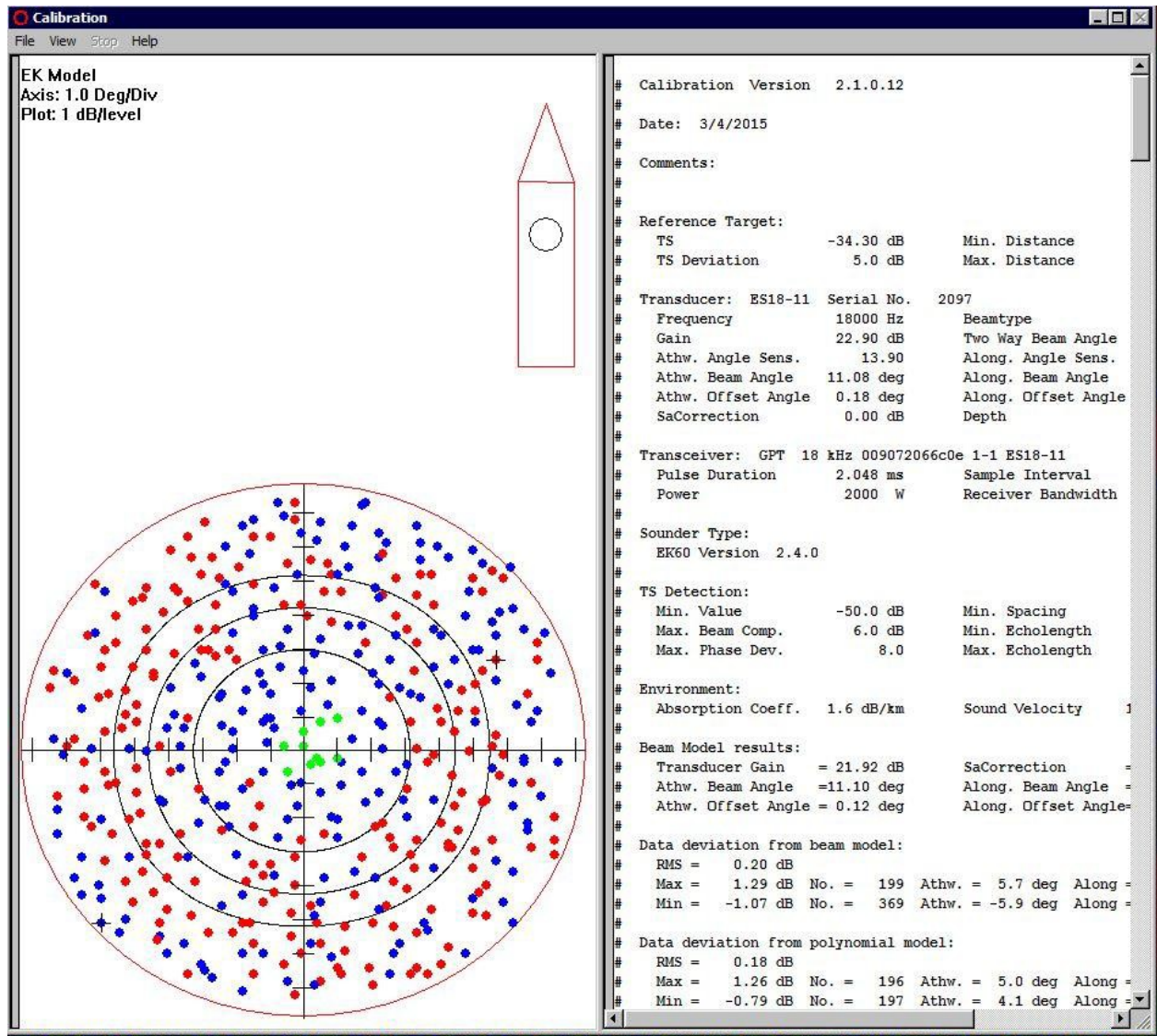


Figure 2. Screenshot of ER60 software calibration results for 18 kHz calibration at 2.048 ms.

18 kHz: 1.024 ms

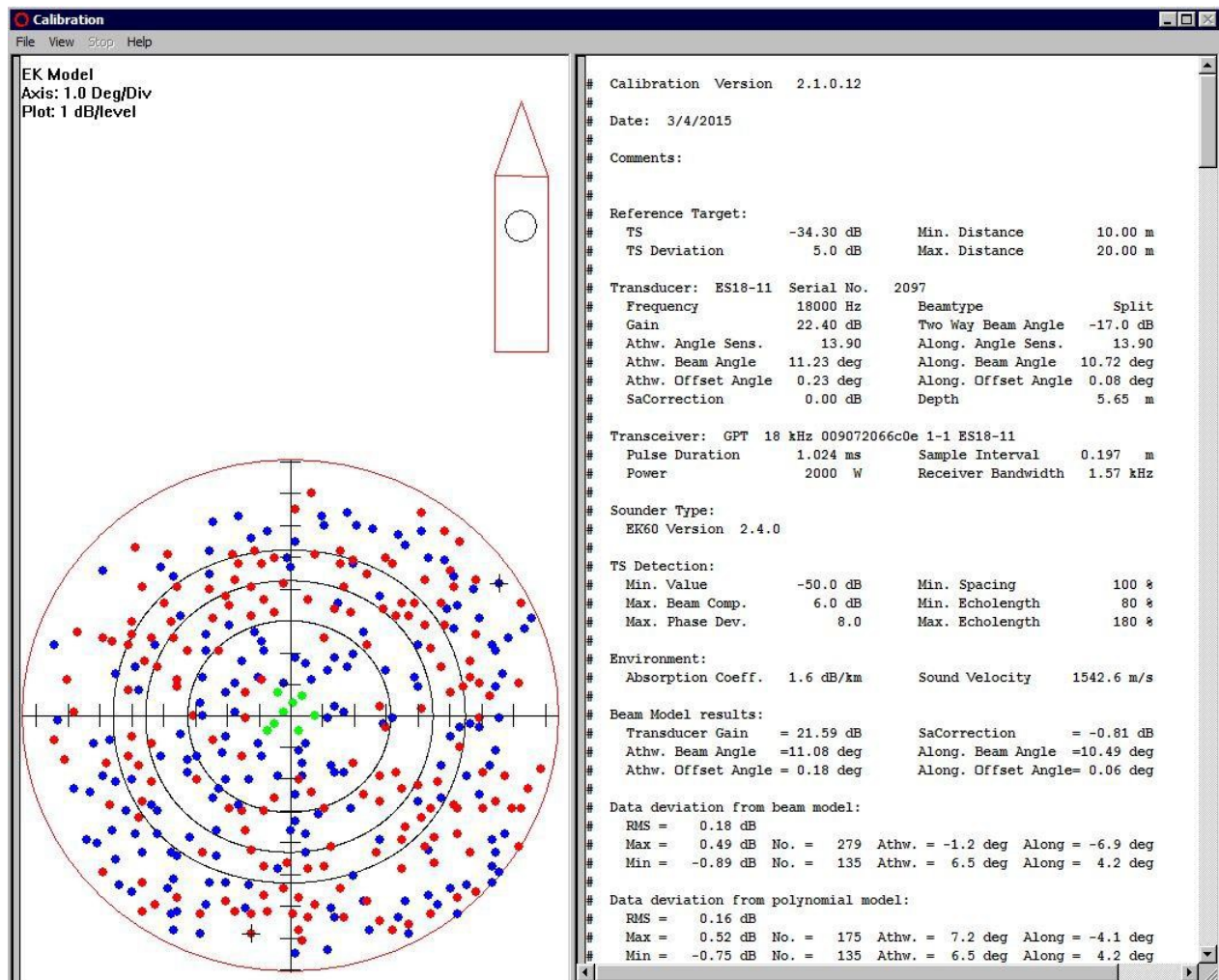


Figure 3. Screenshot of ER60 software calibration results for 18 kHz calibration at 1.024 ms.

18 kHz: 0.512 ms

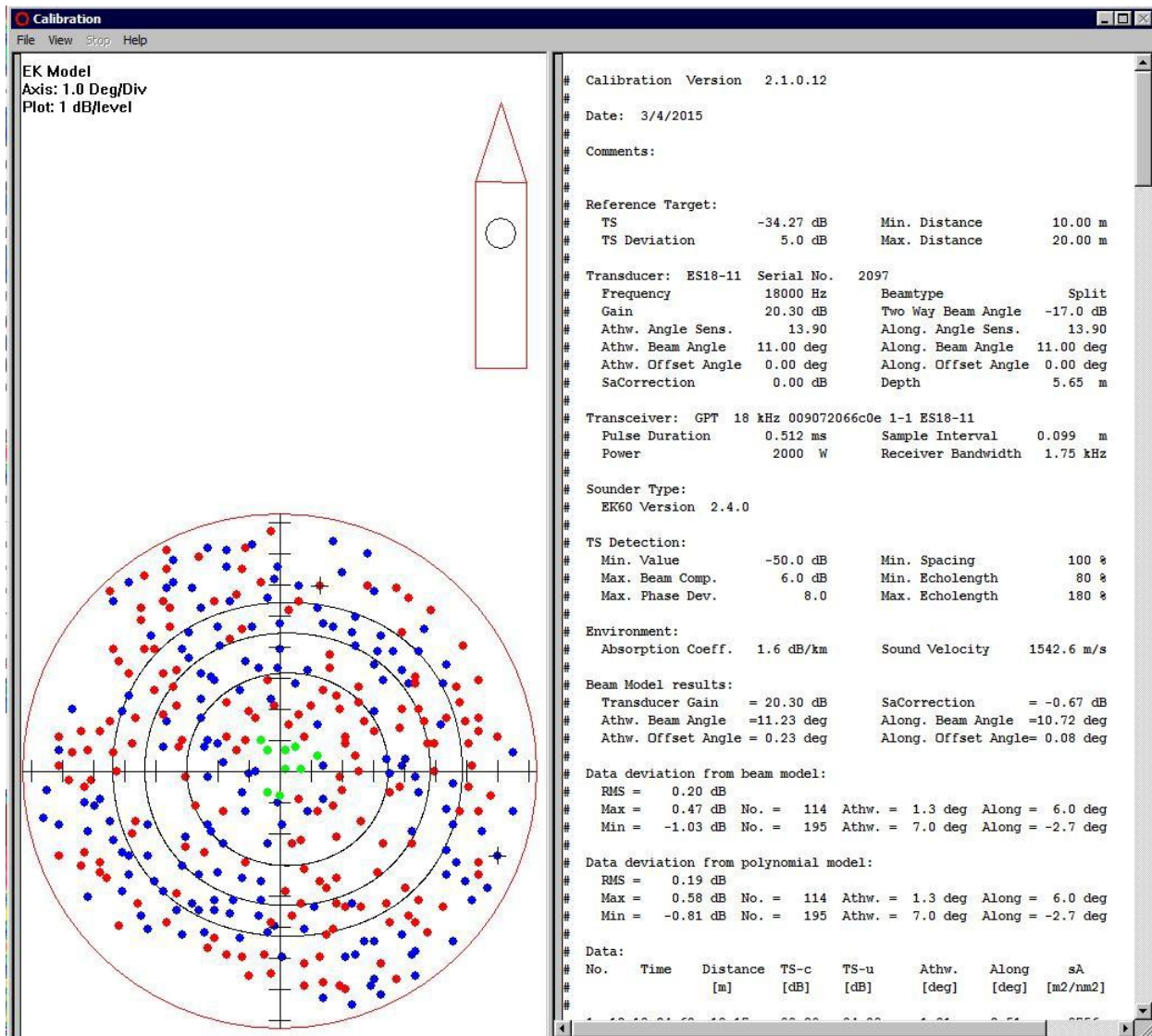


Figure 4. Screenshot of ER60 software calibration results for 18 kHz calibration at 0.512 ms.

Appendix B: Detailed List of .raw and .txt Calibration Files

File name	Date (UTC)	Frequency (pulse length)
Cal_512us-D20150304-T150504.raw	03/04/2015	18 kHz (0.512 ms)
Cal_512us-D20150304-T150504.idx	03/04/2015	18 kHz (0.512 ms)
Cal_512us-D20150304-T150504.bot	03/04/2015	18 kHz (0.512 ms)
Cal_1024us-D20150304-T155357.raw	03/04/2015	18 kHz (1.024 ms)
Cal_1024us-D20150304-T155357.idx	03/04/2015	18 kHz (1.024 ms)
Cal_1024us-D20150304-T155357.bot	03/04/2015	18 kHz (1.024 ms)
Cal_2048us-D20150304-T162512.raw	03/04/2015	18 kHz (2.048 ms)
Cal_2048us-D20150304-T162512.idx	03/04/2015	18 kHz (2.048 ms)
Cal_2048us-D20150304-T162512.bot	03/04/2015	18 kHz (2.048 ms)
Cal_4096us-D20150304-T172106.raw	03/04/2015	18 kHz (4.096 ms)
Cal_4096us-D20150304-T172106.idx	03/04/2015	18 kHz (4.096 ms)
Cal_4096us-D20150304-T172106.bot	03/04/2015	18 kHz (4.096 ms)

.txt file name	Date (EST ²)
20150304_Cal_512us.txt	03/04/2015
20150304_Cal_1024us.txt	03/04/2015
20150304_Cal_2048us.txt	03/04/2015
20150304_Cal_4096us.txt	03/04/2015

² Note that the .txt files times are in EST and not UTC.

Appendix C: Vessel Offsets for Transducer Hull Locations

Vessel Offsets (meters)			
Transducer	X	Y	Z
ES18-11 (18 kHz)	-0.5234	1.7793	6.7833